Virtual National Laboratory for Heavy Ion Fusion Sciences

Issue Number 3, 2008

HIFS News

Highlights from HIF 2008

The 17th International Symposium on Heavy Ion Inertial Fusion took place in Tokyo, August 4-8, 2008. Previous symposia in this series have been held at intervals of about two years, starting in Berkeley, California, in 1976. The most recent ones were in Princeton, USA in 2004 and in Saint-Malo, France in 2006. The essential role of the symposia, including this one, is to provide a forum among experts, in the fields of heavy ion drivers, beam physics, IFE target design, warm dense matter physics, ion beam and laser interactions with matter, fusion chambers, and inertial fusion power systems. Their goal is to stimulate further progress toward Inertial Fusion Energy production and basic understanding of associated science and technologies.

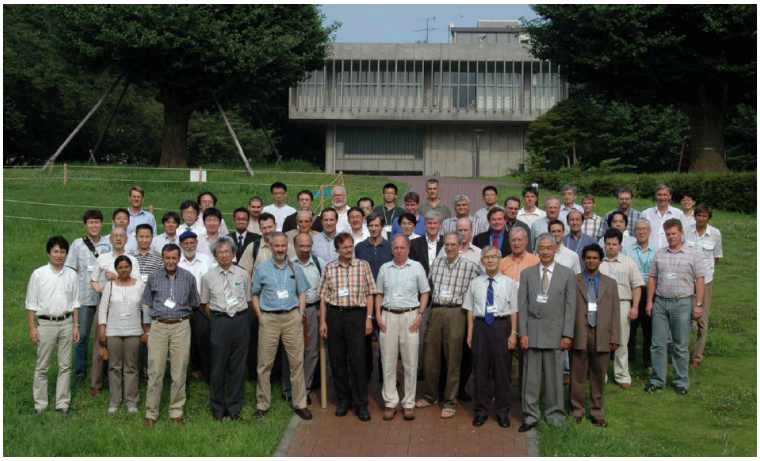

Figure 1: photo of most of the participants at the Symposium.

Heavy-ion accelerators are promising candidate drivers for energy production due to their high repetition rate and efficiency. This applies both to the RF linac and storage ring scheme pursued in Europe, Rusia, and Japan and the induction linac approach being explored by the US community. This symposium also included recent progress in petawatt-laser production of intense proton and heavy ion beams as possibly useful injectors for heavy ion accelerators. A positive emphasis was also given to the ion production of strongly coupled and warm dense matter as part of the fundamental knowledge base needed for inertial fusion target physics. There was a total of 67 participants (see Fig. 1) from 11 countries (Japan 25 USA 18 Germany 6 Russia 4 Italy 3 Spain 1 UK 1 France 1 China 4 Brazil 2 Korea 2) and 62 presentations (6 overview talks, 6 on beam dynamics, 8 on accelerators, 8 on warm dense matter, 4 on ion production, 3 on targets, 5 on atomic physics, and 22 posters); the mix of countries represented has grown.

Over the last five years, US heavy ion research has shifted increased attention to heavy-ion driven WDM physics, but just within the last year new work has begun on heavy ion driven fusion target physics, in particular related to a novel direct drive. Motivated by the new US work in direct drive that the US contingent presented, there was considerable interest expressed by scientific leaders in Japan and Germany to collaborate in a revival of heavy ion inertial fusion energy target physics research.

Focus of US presentations in HIF 08. The US contingent presented recent work on a new, high-coupling-efficiency regime for heavy ion direct drive and the related application of RF beam centroid rotation ("wobbler") techniques, along with hydrodynamic simulations of WDM and direct drive experiments. Theoretical and experimental work was presented on neutralization, on the collective effects and instabilities of intense ions beams in background plasma, on beam compression and focusing in NDCX-I, and on physics designs for injection, acceleration, bunch compression, and solenoidal beam transport in the next step facility NDCX-II. These presentations were on behalf of the HIFS-VNL.

We are beginning to use the intense compressed NDCX-I beams for initial WDM experiments, driven at low ion energies well below the Bragg peak but at a plateau in the dE/dx curve so as to yield reasonably uniform deposition. NDCX-II will operate near the Bragg peak in dE/dx. These approaches are complementary to the use of high-range 50 GeV heavy ion beams at GSI (Darmstadt, Germany) for isochoric target heating; the US approach is intended to heat thin, diagnosable samples with high uniformity. GSI has developed many WDM diagnostics over the last several years, and the HIFS-VNL will benefit from learning to apply similar diagnostics. We presented studies leading toward a "physics design" for NDCX-II, an upgrade to the existing Neutralized Drift Compression Experiment (NDCX) at LBNL, that is to be proposed. NDCX-II will satisfy a pre-requisite for the Integrated Beam-High Energy Density Physics Experiment (IB-HEDPX), for which DOE has approved Critical Decision Zero (CD-0). The discussion following this presentation, and subsequent discussions, enabled the US contingent to better understand how such a facility would fit into the emerging spectrum of world research programs. Indeed, there is considerable interest world-wide in such a facility, including especially interest on the part of researchers from GSI. A new idea was introduced -- halogen-enhanced extraction of negative hydrogen beams -- which might apply some of the knowledge that we learn in our halogen ion-ion plasma studies to improve the extraction and current density of D- beams, for neutral-beam heating of ITER and other MFE devices.

For comments about the content of the HIF News, contact Jean-Luc Vay (Cell 248-961-9115) or JLVay@lbl.gov

To get on the mailing list of the HIF News, send a request to LCHeimbucher@lbl.gov

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy prepared by LBNL under Contract No. DE-AC02-05CH11231, by LLNL under Contract DE-AC52-07NA27344, and by Princeton Plasma Physics Laboratory under contract No. DE-AC02-76CH-O3073.

LBNL-PUB-844-02-2008

Virtual National Laboratory for Heavy Ion Fusion Sciences

Issue Number 3, 2008

HIFS News

Focus of non-US presentations in HIF 08. A presentation from Dr. B Sharkov from ITEP in Moscow, Russia, on "experimental activities on HIF at ITEP" included description of the use of RF wobblers applied to cylindrical targets for WDM and HIF to be tested on FAIR at GSI under a German-Russian collaboration. In a presentation on "robust fuel target in heavy ion inertial fusion", Dr. S. Kawata from Utsunomiya University in Japan shows how beam wobbling in direct drive may reduce RT growth amplitudes significantly. Dr. K. Tanaka from Osaka University in Japan presented a talk on the "study of proton and hot electron characteristics for fact ignition", in which he highlighted ILE-Osaka's increasing focus on alternatives to the conventional cone target with hot electrons for fast ignition. In a presentation on "laser ion source for low charge heavy ion beams", Dr. M. Okamura of Brookhaven National Laboratory showed that a laser ion source (LIS) can provide pulsed intense low-charge-state heavy ions (in contrast with the traditional application of highly charged ions), with a very low temperature and good emittance. They have observed: Carbon, 60 mA (peak, C^{4+} 60 %); and Aluminium. 70 mA (peak, Al^{9+} 65 %). Okamura suggests that the combination of LIS and a Direct Plasma Injection Scheme (DPIS) might be suitable for an HIF scenario; such a combination is being tested using their current experimental setup. The oral presentation by Dr. K. Takayama and the poster by T. S. Dixit, both from KEK in Japan, on the KEK "Digital Accelerator / All-Ion Accelerator" introduced a system that may have broad applicability for basic science studies in the US and elsewhere.

Additional information and the full program are available from the conference web site at: http://www.nr.titech.ac.jp/hif2008/index.html. The US presentations and associated manuscripts are listed at: http://hifweb.lbl.gov/public/HIF2008/index ; most can be downloaded using links therein.

- The attendees to HIF'08 from the HIFS-VNL.

For comments about the content of the HIF News, contact Jean-Luc Vay (Cell 248-961-9115) or JLVay@lbl.gov

To get on the mailing list of the HIF News, send a request to LCHeimbucher@lbl.gov

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy prepared by LBNL under Contract No. DE-AC02-05CH11231, by LLNL under Contract DE-AC52-07NA27344, and by Princeton Plasma Physics Laboratory under contract No. DE-AC02-76CH-O3073.

LBNL-PUB-844-02-2008